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Importance of hip capsular repair in total hip arthroplasty (THA) via the posterior lateral approach: a five year retrospective cohort study

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Abstract

Purpose This study aims to assess the impact of repairing the hip joint capsule during posterior-lateral approach total hip arthroplasty (THA) on postoperative hip joint function and late dislocation incidence.

Methods A retrospective cohort study included 413 patients, divided into experimental (hip joint capsule repair, $n=204$) and control (hip joint capsule excision, $n=209$) groups. Patients were followed for five years, evaluating postoperative hip range of motion (ROM), dislocation rate, VAS and HHS scores, inflammatory and coagulation markers, hospitalization, blood loss, and body composition. Statistical analysis included the Student's t-test, Chi-square test, and logistic regression for dislocation risk factors.

Results Joint capsule repair improved postoperative hip flexion and extension within six months and at two years postoperatively, internal and external rotation within three months, and abduction and adduction throughout the entire follow-up period ($P<0.05$). Capsular repair also reduced early and late dislocation rates ($P<0.05$). Significant differences in HHS and VAS scores, inflammatory and coagulation indicators, hospitalization, blood loss, and body composition were noted ($P<0.05$). Multivariate logistic regression indicated hip joint repair, rheumatoid arthritis, epilepsy, and sarcopenia as dislocation risk factors ($P<0.05$).

Conclusions Capsular repair during posterior-lateral THA improves postoperative hip function and mobility while reducing dislocation rates, blood loss, pain, inflammation, and economic burden. Patients with rheumatoid arthritis, epilepsy, or sarcopenia require individualized planning and enhanced postoperative care to minimize complications.

Keywords Joint capsule · Posterior-lateral approach · Total hip arthroplasty · Dislocation · Hip joint mobility

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Introduction

Total hip arthroplasty (THA) is regarded as the most effective treatment for various end-stage hip joint diseases and is hailed as one of the most successful surgeries of the 20th century. Currently, in the United States, 116 individuals per 100,000 undergo THA, with an estimated population of 635,000 individuals expected to have undergone THA by 2030 [1]. THA is an effective method for alleviating hip pain, maintaining hip stability, and restoring functional hip motion [2].

The posterior-lateral approach is the most common surgical approach employed in THA. It is characterized by its technical simplicity, versatility, excellent exposure, reduced incidence of ectopic ossification, and preservation of abductor muscle strength [3]. However, its primary drawback, as reported, is the occurrence of early postoperative dislocation, with an incidence ranging from 1 to 9% [4]. Reasons for early dislocation may include lack of patient compliance, insufficient capsule support, abductor muscle laxity, bone or prosthesis impingement, eccentricity mismatch, and component malposition [5]. Studies have indicated that the direct-lateral or anterior-lateral approaches have lower dislocation rates compared to the posterior-lateral approach, possibly due to the preservation of normal joint capsule structure [6]. Previous research has demonstrated that hip capsule repair can effectively reduce the early dislocation rate following THA [3, 4, 7]. In the extended position, the posterior-lateral approach results in a smaller increase in range of motion (ROM) compared to the anterolateral approach. The ultimate goal for patients is to restore normal hip joint function through THA. Preserving the hip joint capsule may protect against hypermobility and associated adverse loading following arthroplasty [8]. This could be a beneficial factor for patients to smoothly engage in early postoperative rehabilitation exercises and improve joint mobility.

However, there is currently no evidence demonstrating whether hip capsule repair has a beneficial impact on postoperative range of motion for the hip joint in patients undergoing THA or whether it reduces the occurrence of late dislocation after surgery. A retrospective cohort study was conducted over a period of five years to compare the effects of complete hip capsule excision with hip capsule repair on patients undergoing THA.

Methods

Study design and ethical review

We retrospectively collected clinical data from patients who underwent THA at our center from January 2014 to January 2019. This study was approved by the ethics committee of our institution and registered with a unique identification number. (Research Registration Number: 2023-KLS-130-01)

Inclusion and exclusion criteria

Inclusion criteria: (1) patients undergoing their initial THA at our center; (2) patients voluntarily participating in this study and providing signed informed consent; (3) age > 18 years. Exclusion criteria: (1) concurrent haematologic disorders such as thrombocytopenia, haemophilia, etc.; (2) concurrent malignancies.

Data collection

All medical records and examination results were collected by a single physician from our electronic medical records system, with follow-ups conducted by the same physician. Another senior physician reviewed and confirmed the accuracy of the data. Recorded information included: age, height, weight, body mass index (BMI), medical history, hospital stay duration, surgery duration, preoperative haematocrit (HCT), hip ROM, harris hip score (HHS) score, visual analog scale (VAS) score, total blood loss (TBL), visible blood loss (VBL), occult blood loss (OBL), C-reactive protein (CRP), erythrocyte sedimentation rate (ESR), activated partial thromboplastin (APTT), d-dimer, erythrocyte count, haemoglobin (HB) level, and albumin level.

Potential complications included hip dislocation, deep venous thrombosis (DVT), pulmonary embolism (PE), and postoperative infection. Doppler ultrasound was used to check for the DVT and PE.

The calculation for total blood loss involves the Eq. [9]: Preoperative blood volume (PBV) * (Preoperative HCT – Postoperative HCT)/ (Preoperative HCT + Postoperative HCT) * 2. PBV = k1 * height (m) ^{3} + k2 * weight (kg) + k3 (male: k1 = 0.3669, k2 = 0.03219, k3 = 0.6041; female: k1 = 0.3561, k2 = 0.03308, k3 = 0.1833). OBL = TBL – VBL.

ROM measurement: ROM (flexion-extension): The patient is positioned in the supine position. Goniometer placement: The fulcrum is positioned at the lateral aspect of the greater trochanter. The stationary arm points towards the lateral aspect of the pelvis, while the moving arm is aligned parallel to the long axis of the femur. ROM (internal-external rotation): The patient is positioned in the supine position. Goniometer placement: The fulcrum is located at the midpoint of the tibial plateau, with both the stationary arm and the moving arm aligned parallel to the long axis of the tibia. When the hip rotates internally, the stationary arm remains in its original position, perpendicular to the ground,

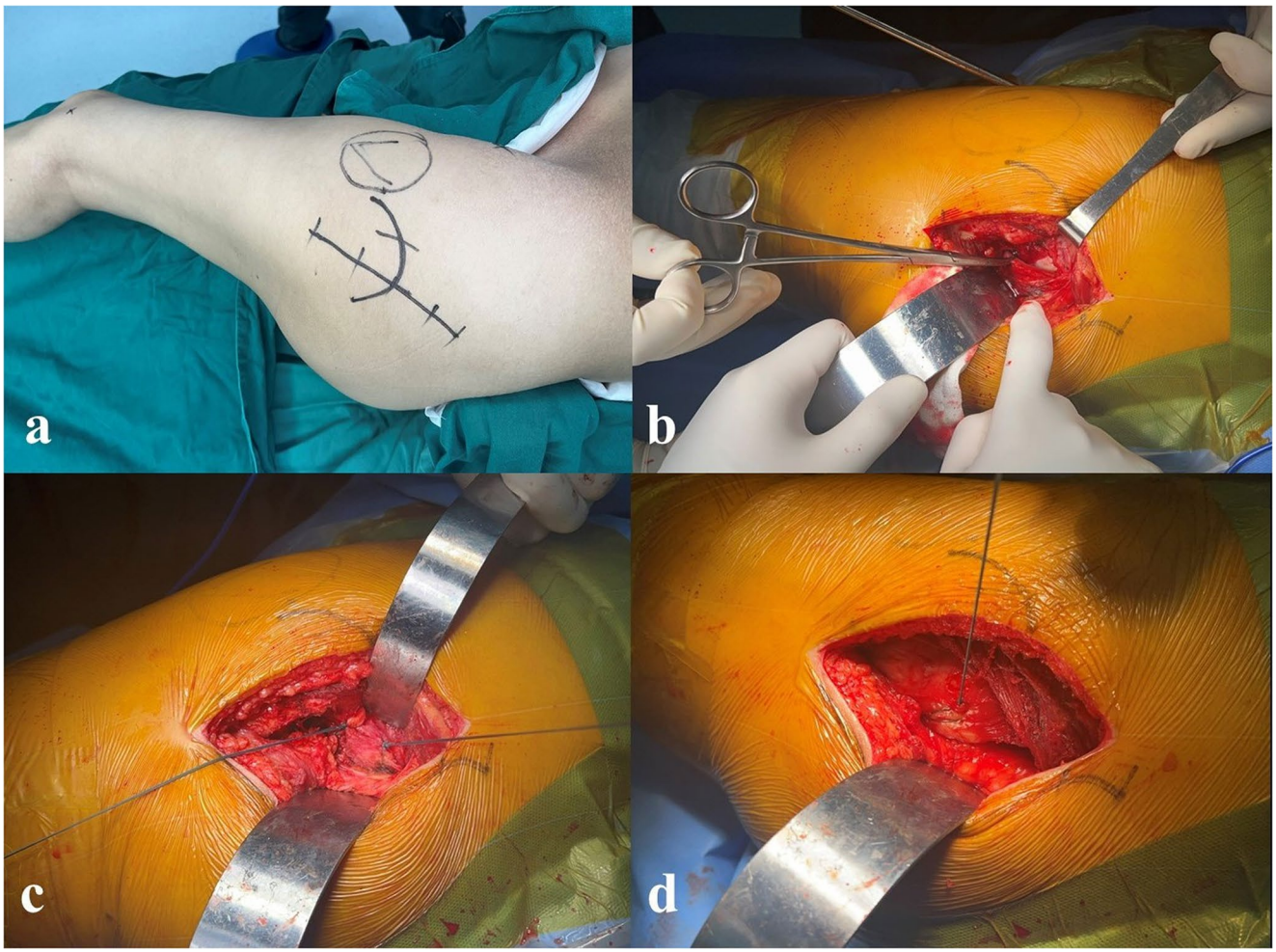

Fig. 1 Surgical procedure. **a:** The patient was assumed with a lateral decubitus position. The incision of the posterior-lateral approach was labelled on the skin; **b:** Exposing the joint capsule. The tissue grasped by the hemostatic forceps in the figure is the joint capsule; **c:** Repair of the posterior moscle and capsule flaps; **d:** Repair of the external rotator muscles

while the moving arm follows the movement of the tibia. ROM (abduction-adduction): The patient is positioned in the supine position. Goniometer placement: The fulcrum is located at the anterior superior iliac spine. The stationary arm aligns with the line connecting both the anterior and superior iliac spines, while the moving arm is parallel to the long axis of the femur. Measurements were conducted by two orthopaedic doctors, and the consistency of the results was examined through Cronbach's alpha test.

Perioperative management and operation method

All surgeries were performed by the same senior surgeon from our team. All patients underwent a posterior-lateral surgical approach. After anaesthesia induction, positioning adjustments, and surgical site sterilization, the skin, subcutaneous tissue, and fascia were incised. Blunt dissection of the gluteus maximus muscle was performed, followed by entry along the intermuscular plane and partial detachment of the external rotator muscles near their insertions. A "T"-shaped incision in the joint capsule exposed the hip joint. The hip joint was dislocated, and the femur was osteotomized approximately 1.5 cm from the trochanteric tip. The femoral head was then removed, and any osteophytes and synovial tissue around the acetabulum were cleared. The tear was identified, and the acetabulum was reamed to the appropriate position at 45° abduction and 15° anteversion, followed by the insertion of a polyethylene liner. The proximal femur was exposed, and the medullary canal was widened in a 15° anteversion direction for the implantation of a biological femoral stem. A short neck and ceramic head were installed, and the hip joint was reduced. In the experimental group, the hip joint capsule was preserved. After the joint was repositioned, non-absorbable sutures were used to stitch the ends of the capsule together. A 2 mm drill was then used to create a hole in the greater trochanter, through which the capsule and the piriformis tendon were reattached to the posterior edge of the greater trochanter. In the control group,

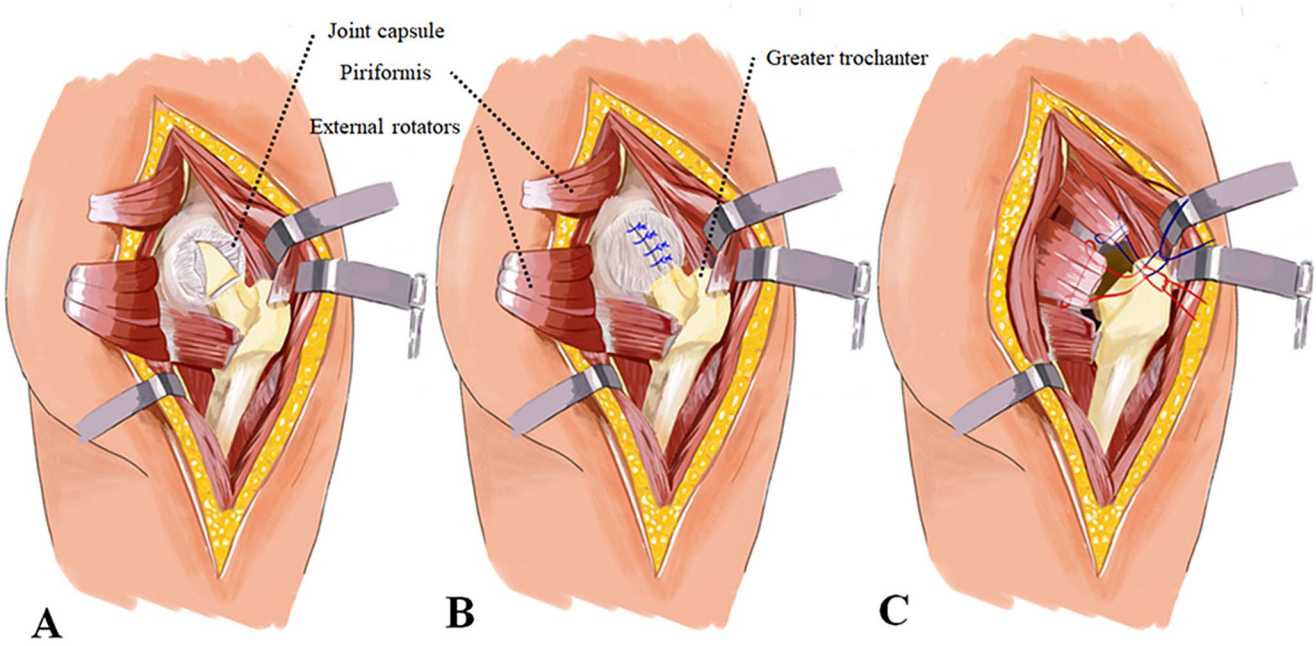

Fig. 2 Joint capsular and external rotator muscle repair. **A:** "T"-shaped incision in the joint capsule exposed the hip joint; **B:** Capsular repair in its original position; **C:** Drill holes in the greater trochanter and repair the external rotator muscles and the piriformis muscle to the greater trochanter

the posterior hip joint capsule was removed, but all other steps were the same as in the experimental group (Fig. 1) (Fig. 2).

Both groups received the same postoperative antibiotic regimen for infection prophylaxis, along with compression stockings and pneumatic compression devices to prevent thrombosis formation. All patients started rehabilitation on postoperative day five with the same rehabilitation program.

Statistical analysis

Data analyses were conducted using SPSS 25.0 (IBM, Armonk, NY, USA). Descriptive statistics were presented as mean ± standard deviation or frequencies (percentages). Normality was assessed with the Shapiro-Wilk test. Student's t-test and Mann-Whitney U test were used for data accordingly. Chi-square test was applied for categorical variables. Logistic regression identified factors impacting hip dislocation. A p-value < 0.05 was considered statistically significant.

Results

Patient participation and demographics

During the study, 449 patients underwent THA. Eight patients were lost to follow-up due to missing records. Six patients were lost to follow-up and considered dropouts. Twelve patients had blood disorders, and ten patients had tumour histories. Eventually, 413 patients were included and followed for up to five years. The experimental group ($n = 204$) had joint capsule repair, and the control group ($n = 209$) had capsule excision. The power analysis for both groups was 96%. Cronbach's alpha test presented good consistency of the measurements ($\alpha > 0.75$). Demographic data, including age, height, weight, BMI, medical history, and preoperative parameters, showed no significant differences between groups ($P > 0.05$) (Table 1).

Hip joint function and dislocation

Joint capsule repair improves postoperative hip joint ROM, notably in flexion-extension at 6 months and the second year ($P < 0.05$), internal-external rotation at three months ($P < 0.05$), and abduction-adduction throughout follow-up ($P < 0.05$) (Table 2).

Furthermore, it improves patients' postoperative HHS scores at 6 months and the third year ($P < 0.05$). Additionally, it reduces postoperative hip joint dislocation rates, both early (within 6 months) and late (after 6 months) ($P < 0.05$) (Table 3).

Volume of blood loss, hospitalization and pain

Joint capsule repair reduces postoperative blood loss, with significant differences in TBL and OBL ($P < 0.05$), while VBL shows no significant difference ($P > 0.05$). It also alleviates early postoperative pain that persists within the first month ($P < 0.05$). Moreover, it shortens hospital stays and

Table 1 Preoperative demographics

Patient demographics	Experimental Group ($n=204$)	Control Group ($n=209$)	P
Age (years)	61.67 ± 11.31	63.06 ± 11.75	0.221
Sex (n)			0.086
Male	52.5% (107/204)	44.0% (92/209)	
Female	47.5% (97/204)	56.0% (117/209)	
Height (cm)	161.52 ± 7.02	161.96 ± 6.11	0.495
Weight (kg)	59.99 ± 9.89	60.03 ± 6.98	0.965
BMI (kg/m^2)	23.10 ± 2.72	22.84 ± 1.78	0.241
Personal History and Past Medical History (n)			
Smoking History	44.1% (90/204)	37.8% (79/209)	0.192
Drinking History	70.1% (143/204)	75.1% (157/209)	0.252
Hypertensive	40.2% (82/204)	35.4% (74/209)	0.316
Heart Disease	24.0% (49/204)	27.3% (57/209)	0.449
Hepatitis	11.8% (24/204)	14.4% (30/209)	0.435
Diabetes	11.8% (24/204)	16.3% (34/209)	0.188
Osteoporosis	46.1% (94/204)	50.2% (105/209)	0.398
Rheumatoid Arthritis	5.9% (12/204)	6.7% (14/209)	0.733
Epilepsy	3.4% (7/204)	6.2% (13/209)	0.187
Sarcopenia	20.6% (42/204)	25.8% (54/209)	0.207
Sleep Disorder	6.4% (13/204)	4.8% (10/209)	0.482
Preoperative HCT (%)	38.32 ± 4.48	37.88 ± 4.58	0.330
Preoperative HB (g/L)	130.66 ± 15.66	128.46 ± 14.43	0.140
Preoperative erythrocyte count (10^12/L)	4.20 ± 0.53	4.13 ± 0.56	0.208
Preoperative CRP (mg/L)	6.74 ± 4.86	6.78 ± 10.19	0.954
Preoperative D-dimer (mg/L)	0.74 ± 0.98	1.57 ± 12.34	0.341
Preoperative APTT (s)	27.88 ± 2.69	27.97 ± 2.94	0.744
Preoperative VAS score	5.76 ± 1.65	5.69 ± 1.66	0.664
Preoperative HHS score	60.81 ± 8.29	60.34 ± 7.57	0.548
Preoperative ESR(mm/h)	10.48 ± 7.49	11.87 ± 10.47	0.120
Preoperative albumin protein (g/L)	39.32 ± 3.91	38.63 ± 6.17	0.174
ROM (Flexion/Extension) (°)	63.67 ± 9.85	62.19 ± 11.62	0.164
ROM (Internal−/External-Rota) (°)	44.19 ± 6.42	43.67 ± 6.76	0.426
ROM (Adduction/Abduction) (°)	44.20 ± 5.21	43.58 ± 5.69	0.251

reduces costs ($P<0.05$). Additionally, it does not prolong surgery duration ($P>0.05$) (Table 3).

Inflammatory indicators and coagulation indicators

Inflammation levels were lower in the experimental group than in the control group, but CRP was statistically different between the two groups only on postoperative day seven, and ESR was statistically different between the two groups within seven days after surgery. Additionally, the experimental group exhibited shorter APTT times postoperatively, which persisted for up to seven days. At discharge, the experimental group exhibits lower d-dimer levels than the control group (Table 4).

Body composition and complications

Joint capsule repair reduces the postoperative decline in patients' erythrocyte count, HB level, and albumin level. Significant differences in erythrocyte count were noted on the first day postoperatively, while HB levels differed significantly within four days. Albumin levels showed significant differences on the fourth day postoperatively and at discharge (Table 4). All patients remained free from DVT, PE, and infection during hospitalization.

Univariate and multivariate logistic regression

We conducted logistic regression analysis for dislocation and performed stepwise regression to screen variables including group, HB, APTT, rheumatoid arthritis, epilepsy, sarcopenia, ROM (flexion/extension), and OBL for multivariate logistic regression. The results indicated a significant correlation between hip joint capsule repair, rheumatoid arthritis, epilepsy, muscular dystrophy, and postoperative hip joint dislocation ($P<0.05$) (Table 5).

Table 2 Hip joint function

Element	Experimental Group (n = 204)	Control Group (n = 209)	P
HHS score			
POD1	46.12 ± 7.73	42.15 ± 7.29	< 0.001
POD7	52.44 ± 7.74	47.39 ± 7.93	< 0.001
POD14	61.12 ± 8.05	57.22 ± 7.59	< 0.001
POM1	71.58 ± 6.19	67.12 ± 7.24	< 0.001
POM3	80.21 ± 5.69	76.91 ± 6.56	< 0.001
POM6	83.42 ± 5.32	82.33 ± 5.51	0.043
POM12	86.83 ± 4.52	86.17 ± 4.60	0.139
POM24	88.65 ± 3.68	88.11 ± 4.09	0.165
POM36	90.01 ± 3.11	89.32 ± 3.67	0.039
POM48	90.27 ± 2.28	89.88 ± 2.68	0.113
POM60	90.08 ± 2.62	90.39 ± 2.20	0.201
ROM (Flexion/Extension) (°)			
POD7	56.05 ± 10.84	52.01 ± 11.79	< 0.001
POD14	70.88 ± 7.56	65.33 ± 8.50	< 0.001
POM1	90.97 ± 6.89	86.57 ± 8.73	< 0.001
POM3	110.68 ± 7.33	106.90 ± 7.12	< 0.001
POM6	122.78 ± 7.92	120.05 ± 8.32	0.001
POM12	124.33 ± 7.04	123.17 ± 6.50	0.082
POM24	124.86 ± 6.44	123.60 ± 6.02	0.041
POM36	125.33 ± 5.46	124.46 ± 4.94	0.092
POM48	125.46 ± 4.78	124.96 ± 4.30	0.265
POM60	126.62 ± 4.27	125.95 ± 4.02	0.099
ROM (Internal−/External-Rota) (°)			
POD7	39.73 ± 5.38	37.30 ± 6.74	< 0.001
POD14	44.22 ± 5.64	41.47 ± 5.66	< 0.001
POM1	59.76 ± 4.99	54.21 ± 4.65	< 0.001
POM3	68.73 ± 4.34	65.18 ± 3.43	< 0.001
POM6	71.69 ± 2.22	71.47 ± 1.97	0.292
POM12	77.19 ± 1.96	76.86 ± 1.92	0.085
POM24	80.55 ± 1.77	80.45 ± 2.89	0.660
POM36	84.71 ± 2.09	84.58 ± 3.10	0.613
POM48	86.27 ± 2.29	86.09 ± 3.58	0.525
POM60	88.43 ± 2.78	88.31 ± 3.72	0.699
ROM (Adduction/Abduction) (°)			
POD7	23.88 ± 6.13	21.12 ± 6.69	< 0.001
POD14	34.86 ± 5.02	30.74 ± 5.37	< 0.001
POM1	40.45 ± 4.67	37.81 ± 5.79	< 0.001
POM3	49.54 ± 5.47	46.05 ± 4.89	< 0.001
POM6	55.57 ± 4.24	51.55 ± 3.88	< 0.001
POM12	61.09 ± 3.29	60.22 ± 3.45	0.01
POM24	62.89 ± 2.81	61.97 ± 3.32	0.003
POM36	62.63 ± 2.35	61.92 ± 2.66	0.004
POM48	62.50 ± 3.00	61.90 ± 3.02	0.045
POM60	63.14 ± 3.09	62.29 ± 3.21	0.006

Abbreviations: POD: postoperative day; POM: postoperative month

Discussions

This study demonstrates that capsular repair in THA patients enhances hip mobility and function, reduces early and late dislocation rates, and mitigates postoperative pain, inflammation, and blood loss. Additionally, repairing the capsule can lead to shorter hospital stays and reduced hospitalization costs. This suggests that hip capsule repair may help patients receive high-quality rehabilitation earlier in the postoperative period, achieve better wound healing

Table 3 Dislocation, volume of blood loss, hospitalization and Pain

Element	Experimental Group ($n=204$)	Control Group ($n=209$)	P
Dislocation (n)	2.5% (5/204)	9.1% (19/209)	0.004
Early dislocation (< 6 month)	0% (0/204)	2.4% (5/209)	0.026
Late dislocation (> 6 month)	2.5% (5/204)	6.9% (14/204)	0.034
TBL(ml)	803.76 ± 345.24	904.22 ± 316.87	0.002
VBL(ml)	383.58 ± 266.50	371.48 ± 205.39	0.605
OBL(ml)	420.18 ± 240.25	532.74 ± 253.04	< 0.001
Length of hospital stay(d)	15.18 ± 5.24	16.93 ± 7.44	0.006
Hospitalization costs (￥)	49272.29 ± 32488.30	56288.29 ± 21126.95	0.009
Length of surgery (h)	1.96 ± 0.63	1.92 ± 0.79	0.556
VAS score			
POD1	6.60 ± 1.09	7.27 ± 1.05	< 0.001
POD7	5.00 ± 1.19	5.72 ± 1.17	< 0.001
POD14	3.67 ± 1.41	4.57 ± 1.54	< 0.001
POM1	2.17 ± 1.10	3.13 ± 1.14	< 0.001
POM3	1.28 ± 0.84	1.42 ± 0.83	0.097
POM6	0.65 ± 0.56	0.76 ± 0.66	0.086
POM12	0.63 ± 0.80	0.72 ± 0.67	0.215
POM24	0.64 ± 0.56	0.64 ± 0.69	0.950
POM36	0.59 ± 0.58	0.60 ± 0.60	0.80
POM48	0.53 ± 0.57	0.58 ± 0.52	0.356
POM60	0.51 ± 0.51	0.54 ± 0.50	0.597

and joint function, contribute to improved patient satisfaction after surgery, and effectively prevent postoperative complications. To our knowledge, this is the first study to investigate the impact of capsular repair in posterior lateral approach THA on postoperative hip activity and late dislocation.

Hip joint mobility is a focal point of concern for us, and enhancing patient hip joint mobility is one of the primary objectives of THA. Hip joint mobility is influenced by a variety of factors, including prosthesis selection, prosthesis implant position, soft tissue tension, postoperative rehabilitation, and patient compliance [6]. Our research findings indicate that joint capsule repair can improve patient hip joint ROM. We attribute this improvement to early postoperative rehabilitation for patients. Hip capsule repair may provide a protective effect during rehabilitation exercises [10], allowing patients to engage in more effective training. This can lead to improved hip joint ROM, ultimately enhancing postoperative satisfaction and quality of life. Upon discharge, patients are advised to engage in long-term and consistent rehabilitation exercises. At the three month follow-up, there was a significant difference in hip ROM between the two groups. At the six month follow-up, there was no significant difference in hip internal and external rotation between the two groups. At the final follow-up, differences in hip joint ROM (adduction and abduction) persisted, possibly attributed to variations in early rehabilitation activities and patient comprehension of rehabilitation training (Fig. 2, Details can be found in the supplementary materials). Dislocation represents the primary complication of THA utilizing the posterior-lateral approach [11]. This approach is widely used in clinical practice because of its small incision, which provides a clear surgical field and allows femoral osteotomies. However, this approach is associated with a heightened risk of postoperative dislocation due to the trauma inflicted on the ligamentous structures and external rotator muscles. Pellicci et al. [12] proposed restoring the posterior hip structures to mitigate early dislocations. Early dislocations occur within 6 months postoperatively, while late dislocations manifest after this period. Our findings indicated no dislocations within the initial six months postoperatively in the experimental group, resulting in a dislocation rate of 0%, contrasting with five occurrences in the control group, yielding a 2.4%. This underscores the efficacy of joint capsule repair in reducing early dislocation, consistent with prior research. Subsequent to six months postoperatively, 5 patients in the experimental group and 14 in the control group experienced dislocations, resulting in rates of 2.5% and 6.9%, respectively. This indicates that joint capsule repair can also decrease the incidence of late dislocation. Repairing the hip joint capsule enhances soft tissue stability and joint integrity, thereby diminishing dislocation risk. Hence, we think of hip joint capsule repair as indispensable in the posterior-lateral approach to THA. Notably, among dislocated individuals in the experimental group, three incidents stemmed from falls, whereas the control group witnessed nine post-fall dislocations.

Table 4 Inflammatory indicators, coagulation indicators and body composition

Element	Experimental Group ($n=204$)	Control Group ($n=209$)	P
CRP (mg/L)			
POD1	24.91 ± 30.17	29.34 ± 29.56	0.132
POD4	42.98 ± 39.65	46.53 ± 36.02	0.342
POD7	26.37 ± 28.10	33.39 ± 23.15	0.006
At discharge	16.58 ± 18.05	15.88 ± 12.01	0.645
ESR (mm/h)			
POD1	11.30 ± 11.57	15.10 ± 12.36	0.001
POD4	21.06 ± 13.16	29.44 ± 16.89	< 0.001
POD7	13.62 ± 6.29	18.46 ± 9.69	< 0.001
At discharge	12.40 ± 6.95	11.98 ± 6.13	0.519
D-dimer (mg/L)			
POD1	5.24 ± 7.66	4.36 ± 7.78	0.245
POD4	6.31 ± 5.68	5.87 ± 8.48	0.533
POD7	5.83 ± 4.51	5.76 ± 10.23	0.926
At discharge	3.84 ± 2.57	3.25 ± 2.06	0.01
APTT (s)			
POD1	29.47 ± 3.49	31.35 ± 5.74	< 0.001
POD4	29.30 ± 3.37	31.03 ± 4.78	< 0.001
POD7	28.94 ± 2.99	29.75 ± 3.77	0.016
At discharge	28.77 ± 2.33	28.67 ± 2.84	0.696
HB			
POD1	117.75 ± 17.37	113.34 ± 16.65	0.009
POD4	102.89 ± 16.30	98.81 ± 14.27	0.007
POD7	111.12 ± 13.22	109.17 ± 15.97	0.178
At discharge	120.72 ± 12.89	118.12 ± 15.84	0.068
Erythrocyte count			
POD1	3.89 ± 0.60	3.71 ± 0.58	0.002
POD4	3.35 ± 0.53	3.27 ± 0.46	0.084
POD7	3.29 ± 0.47	3.23 ± 0.52	0.186
At discharge	3.42 ± 0.47	3.33 ± 0.52	0.057
Albumin			
POD1	32.68 ± 3.62	33.11 ± 3.75	0.230
POD4	32.52 ± 2.87	33.75 ± 2.97	< 0.001
POD7	34.03 ± 3.05	34.83 ± 3.28	0.011
At discharge	34.78 ± 2.82	35.89 ± 3.21	< 0.001

Consequently, we emphasize the imperative of postoperative patient education on fall prevention in daily activities.

Logistic regression analysis indicates that hip joint capsule repair, rheumatoid arthritis, epilepsy, and sarcopenia are associated with dislocation. This reaffirms the beneficial role of hip capsule repair in preventing postoperative dislocation. Some studies have found that rheumatoid arthritis patients undergoing THA are at a higher risk of hip prosthesis dislocation [13–16]. Anatomical differences in the hip joint between rheumatoid arthritis and osteoarthritis patients may be the cause of the increased risk of postoperative dislocation in rheumatoid arthritis patients. Research indicates that rheumatoid arthritis patients have an increased likelihood of developing protrusio acetabula. Anterior acetabular protrusion may elevate the risk of hip impingement and posterior dislocation [17]. Previous studies have found that patients with epilepsy have a higher incidence of dislocation after THA, which may be related to an increased risk of falls [18]. Previous studies suggest that patients with sarcopenia have a higher risk of complications following THA [19, 20]. This may be due to reduced skeletal muscle mass and insufficient tension in soft tissues among sarcopenic patients. Furthermore, surgical-induced muscle damage in sarcopenia patients may exacerbate the decline in muscle strength, thereby increasing the risk of dislocation occurrence. In the future, it is imperative to devise personalized surgical plans for patients with rheumatoid arthritis, epilepsy, and sarcopenia undergoing THA. Enhanced postoperative precautions are essential to mitigate risks like falls. Tailored postoperative rehabilitation programs are recommended to enhance muscle strength and reduce the risk of postoperative dislocation.

Table 5 Univariate and multivariate logistic regression

Independent variable	Single factor logistic regression		Multiple logistic regression	
	HR (95% CI)	*P*	HR (95% CI)	*P*
Group	3.98(1.46–10.87)	**0.007**	18.60(1.125-307.589)	**0.041**
Age	1.001(0.966–1.1038)	0.955		
Sex	1.323(0.574–3.051)	0.511		
Height	1.00(0.939–1.065)	0.993		
Weight	1.011(0.965–1.060)	0.633		
BMI	1.061(0.897–1.254)	0.491		
Smoking History	0.361(0.132–0.987)	0.478		
Drinking History	1.138(0.440–2.944)	0.798		
Hypertensive	0.988(0.422–2.314)	0.977		
Heart Disease	1.806(0.766–4.259)	0.177		
Hepatitis	0.589(0.135–2.580)	0.483		
Diabetes	1.241(0.408–3.770)	0.704		
Osteoporosis	1.875(0.794–4.345)	0.154		
Rheumatoid Arthritis	126.667(40.671-394.494)	**< 0.001**	253.131(17.439-3674.237)	**< 0.001**
Epilepsy	23.071(9.703–75.531)	**< 0.001**	63.050(3.069-1295.291)	**0.007**
Sarcopenia	29.307(8.518-100.834)	**< 0.001**	40.671(2.720-608.160)	**0.007**
Sleep Disorder	0.725(0.094–5.622)	0.759		
HCT	1.078(0.982–1.183)	0.116		
HB	1.030(1.003–1.059)	**0.032**	0.987(0.941–1.036)	0.599
Erythrocyte count	1.891(0.890–4.018)	0.098		
CRP	1.014(0.974–1.056)	0.499		
D-dimer	0.981(0.787–1.223)	0.865		
APTT	1.166(1.044–1.302)	**0.007**	1.206(0.899–1.617)	0.211
VAS score	1.133(0.880–1.459)	0.333		
HHS score	0.988(0.938–1.041)	0.657		
ESR	1.021(0.984–1.059)	0.279		
Albumin protein	1.103(0.994–1.224)	0.065		
ROM (Flexion/Extension)	0.951(0.920–0.983)	**0.003**	0.945(0.887–1.006)	0.074
ROM (Internal−/External-Rota)	0.942(0.883–1.005)	0.070		
ROM (Adduction/Abduction)	0.937(0.863–1.018)	0.124		
TBL	1.001(1.000-1.002)	0.164		
VBL	1.000(0.998–1.001)	0.652		
OBL	1.002(1.000-1.003)	**0.025**	1.002(0.998–1.005)	0.369
Length of hospital stay	0.978(0.913–1.048)	0.526		
Hospitalization costs	1.00(1.000–1.000)	0.998		
Length of surgery	0.995(0.985–1.006)	0.403		

Bold font indicates $P < 0.05$

Perioperative pain management is also a crucial aspect of THA [21]. Studies have indicated that severe postoperative pain significantly affects patients' early rehabilitation training and surgical satisfaction [22]. There is a correlation between postoperative pain and postoperative bleeding, as well as the level of postoperative inflammation [23]. In the early postoperative period, patients typically experience significant pain, which makes early rehabilitation exercises difficult. Our study indicates that capsular repair of the hip joint can alleviate early postoperative pain in patients, primarily observed within the first day to one month after surgery (Details can be found in the supplementary materials). This indicates that patients can achieve better rehabilitation outcomes in the early stages. Additionally, the experimental group exhibited lower levels of TBL, OBL, and inflammatory markers compared to the control group (Details can be found in the supplementary materials). During our follow-up period, neither group of patients experienced postoperative infections. We think that the reduction in postoperative blood loss may have reduced the stress response to surgical trauma, thereby leading to a decrease in postoperative inflammatory levels. Postoperative anaemia is a common adverse event following surgery. Research indicates that postoperative anemia is associated with adverse events [24]. Albumin is linked to wound healing postoperatively. Postoperative nutritional status is considered an essential aspect of surgical recovery [25]. Our study found a higher postoperative erythrocyte count, HB level, and

albumin level in the experimental group compared to the control group. We think this may be related to reduced postoperative bleeding. This indicates that joint capsule repair may reduce postoperative loss of body composition and contribute to early recovery in patients. DVT and PE are among the risks following THA [26]. Our study found that the experimental group had shorter APTT times compared to the control group, and this difference persisted for up to seven days postoperatively. Additionally, the experimental group had lower levels of D-dimer at discharge compared to the control group. However, the APTT and D-dimer levels for both groups remained within the normal range. During hospitalization, we did not observe any cases of DVT or PE in either group.

Furthermore, we found that the experimental group had shorter hospital stays and lower hospitalization costs compared to the control group, with no difference in surgical duration between the two groups. Some studies indicate that reducing hospitalization time can alleviate patients' financial burden [27, 28]. This implies that hip capsule repair may alleviate patients' financial burden, potentially easing government economic pressures. Additionally, our study has several limitations. Firstly, it is a retrospective study; hence, the data collected is limited. Secondly, we only conducted a five year follow-up, and a longer follow-up period might be needed to assess the impact of hip capsule repair.

Conclusions

In posterior-lateral THA, repairing the joint capsule is crucial. It improves postoperative hip joint function and mobility, reducing early and late dislocation risks. This method also lowers postoperative blood loss, pain, inflammation, and economic burden. For patients with rheumatoid arthritis, epilepsy, or sarcopenia undergoing THA, personalized evaluations, surgical plans, protective measures, and rehabilitation programs are vital to minimizing complications, including dislocations.

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Author contributions All authors had full access to the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. Conceptualization, H.S. and S.X.Y.; Methodology, H.S. and H.H.; Investigation, H.H. and Z.Y.Z.; Formal Analysis, H.S.; Resources, T.T.X. and P.J.T.; Writing - Original Draft, H.S. and Y.S.X.; Writing - Review & Editing, S.N.L, X.Y.H, S.C.X., Y.C.G. H.J.Z., L.C., T.T.X., and P.J.T.; Visualization, H.S., S.N.L, X.Y.H., J.Y.L., and J.L.; Supervision, T.T.X.; Funding Acquisition, T.T.X. and P.J.T.

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Declarations

Ethical approval This study was approved by the Ethics Committee of the First Affiliated Hospital of Zhejiang Chinese Medical University (the study registration number is 2023-KLS-130-01). This study did not involve direct contact with humans or animals.

Informed consent Informed consent was obtained from all participants. All research was performed in accordance with relevant guidelines/regulations.

Conflict of interest The author(s) declare no potential competing interests in the research, authorship, and/or publication of this article.

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